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ABSTRACT

This study examined how instruction that encourages critical thinking about what has been read can lead to incorporated knowledge that can be retrieved and applied to other related settings. Case-based learning (an instructional method long used with graduate business, law, and medical students) is one method that can be used to foster critical thinking and schema construction. For this study, a case was defined as a narrative that presented a theme portrayed in a novel but presented it in a problem-solving format that related text ideas to real-world situations. The effects of case based instruction were compared to those of traditional instruction on students' ability to assemble and incorporate different knowledge sources in memory. Ninety-two ninth graders in a rural community participated in the 6-week study. The students read the novel "To Kill a Mockingbird" and were evaluated by their written responses to essays and timed writings. Findings indicated that activating and expanding knowledge through the use of thematically organized and cross-disciplinary cases facilitated students' ability to generate explanations for new information that were plausible and meaningful. (One table of data is included, and 40 references are attached.) (SR)

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Knowledge Activation and Schema Construction

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ABSTRACT

This study investigated the effects of case base instruction, compared to traditional instruction, on students' ability to assemble and incorporate different knowledge sources in memory. Ninety-two ninth graders participated in this six week study. Students were evaluated by written responses to essays and timed writings. The findings indicated that activating and expanding knowledge through the use of thematically-organized and cross-disciplinary cases facilitated students' ability to generate explanations for new information that were plausible and meaningful.

Knowledge Activation and Schema Construction

Reading comprehension demands that readers activate existing knowledge so that new ideas can be incorporated in their cognitive structure. This does not mean learning and storing information in compartmentalized units, but it means that students' knowledge is extended when novel ideas are incorporated in their existing knowledge structures for later retrieval and application to other relevant settings. Unfortunately, in many school experiences students find information presented in a way that is artificial and not meaningful. Learning experiences are artificial because the information that is presented lacks a situational context for students to link new ideas to existing knowledge. In such instances, the school experience emphasizes facts and abstract ideas in a manner that is rarely related to the students' life and community (Donham, 1949). Consequently, students often resort to storing this "artificial" information as comparmentalized units to be later accessed in a specific subject area by way of either question answering or examination (Potts, St. John, & Kirson, 1989). Whitehead (1929) addressed this form of knowledge as being "inert." Inert knowledge is activated when explicitly demanded, but is not spontaneously incorporated into other relevant problem solving contexts.

The focus of this paper is to examine how instruction that encourages critical thinking about what one has read can lead to incoporated knowledge that can be retrieved and applied to other related settings. Incoporation of ideas is achieved by

assembling different knowledge sources in memory (see Sprio, Vispoel, Schmitz, Samarapungavan, & Boerger, 1987). In order for knowledge assembly and incorporation to occur, the role of knowledge activation and how one modifies or constructs schema with new information is an important consideration. In contrast, students have learned to concentrate on those facts and themes which they believe will be tested by the teacher in a given subject instead of reflecting on how facts and ideas can be assembled, related to prior knowledge, and linked to other disciplines containing common conceptual networks.

Educators and researchers have suggested numerous instructional strategies to help students activate and use prior knowledge to aid comprehension (e.g., see Alvarez 1983; Alvarez & Risko, 1989; Risko & Alvarez, 1986; Ausubel, 1960; Alvermann, 1981; Earle & Barron, 1973; Graves, Cook, Laberge, 1983; Mayer, 1987). Yet, there is much evidence that good and poor readers do not use schemata appropriately or are unaware of whether the information they are reading is consistent with their existing knowledge (Bartlett, 1932; Bransford, 1979).

As Bransford (1985) points out, schema activation and schema construction are two different problems. While it is possible to activate existing schemata of a given topic, it does not necessarily follow that a learner can use this activated knowledge to facilitate acquisition of new knowledge and skills. Problem solving lessons and activities, involving critical thinking, can provide learners with situations that require

critical thinking and aid in schema construction.

Critical thinking theory provides an explanation for activating existing schemata and for constructing new ones (Norris & Phillips, 1987; see Siegel, 1988). Critical thinking provides a strategy (see Siegler & Jenkins, 1989) for achieving understanding, and can be accomplished by contrasting ideas and engaging in relfective thinking (Dewey, 1933). A reader can either weigh alternative interpretations, dismiss others, make a decision to evaluate multiple possibilities, or accept information as being reasonable. This process helps students to modify or extend their mental model, or existing knowledge base, of target concepts.

Case-based learning is one method that can be used to foster critical thinking and schema construction. Learning through cases has long been an instructional method used with graduate business, law, and medical students. Such instruction is predicated upon mutual respect for ideas brought about through communication and negotiation of ideas between and among the teacher and students (Christenson, 1987; Dewing, 1931; Gragg, 1954; Lawrence, 1953; Towl, 1969). The case method of teaching and learning provides a forum during which students can develop their own framework to reason and think about problems and situations related to an area of study (Hunt, 1951). Cases that revolve around defined topics and that allow for multidisciplinary study can lead to better comprehension and knowledge transfer -- the applicaton of preexisting knowledge to new

situations (Spiro et al., 1987).

This investigation centered on collaborative teacher/student partnerships that included a cooperative reading/writing plan (Alvarez, 1981, 1989). A premise of this plan is that change occurs when students and teachers become an integral part of the educational equation, and that such activity can enhance conceptual learning across subject disciplines. Related to this research plan are Gowin's (1981/1987) theory of educating, Ausubel's (1960, 1968) cognitive theory of meaningful reception learning, and a constructivist epistemology that provided the philosophical and theoretical background upon which this investigation was designed and results interpreted. Gowin's theory of educating focuses on the educative event and its related concepts and facts. In an educative event, the teacher and learner share meanings and feelings so as to bring about negotiated meaning in a learning experience. Ausubel's learning theory places central emphasis on the deliberate role of the learner (i.e., students cause their own learning).

The purpose of this study was to investigate the effects of case based instruction, compared to traditional instruction, on students' ability to assemble and incorporate different knowledge sources in memory. Specifically, (1) Can cases that present multiple concepts that are embedded in a novel aid students' critical thinking and use of information? and, (2) Can conceptual representations made by students provide an organized scheme for revealing knowledge and creative thought? These research

questions addressed a needs assessment conducted by the principal and faculty of a designated high school that identified a recommendation to improve students' critical thinking and writing skills.

METHOD

Subjects

Ninety-two ninth grade students participated in this six week study. Four intact English classes were selected with their regular teachers providing instruction to the experimental and comparison groups. The experimental (n = 20 + 28 = 48) and the comparision group (n = 22 + 22 = 44) each consisted of two classes and two teachers. Both teachers hold a masters degree and have 9 and 13 years of experience, respectively. Although randomization of subjects could not occur, given an intact setting and trying to maintain a natural classroom environment, a review of standardized test performance, academic records, and pupil placement to a standard ("average") class, determined these four classes as being comparable. The Stanford Acheivement Test (1983), Advanced Level, Form F, was administered to most of these students when they were in seventh grade. Raw scores on the reading comprehension subtest showed a combined class mean for the experimental group (n = 35) of 35.88, SD = 0.16. The comparison group (n = 32) had a combined class mean of 34.13, SD = 0.19. Stanine scores for the same subtest showed a combined class mean of 4.92, SD = 0.07, for the experimental group and

4.81, SD = 0.01, for the comparison group.

The subjects for this study are typical of the high school student body whose families represent professional, blue collar, day labor, and rural homes. This high school is located in a rural community where industry and agriculture (i.e., dairy and tobacco farming) are primary sources of revenue. The occupational survey (GHS Evaluation Report, 1986-87) on parental occupations of twelfth grade students revealed that twenty percent of the parents in GHS, Sumner County, Tennessee, community are professionally employed. Nineteen percent are managers or proprietors, ten percent are in clerical fields, twenty-five percent are skilled workers or foremen, four percent are semi-skilled workers, two percent are unskilled workers, and nineteen percent of the parents hold other jobs. Formal education of these parents varies. Nine percent have advance degrees, sixteen percent have bachelors degrees, nine percent attended a post-seconday school other than a college, twenty-three percent completed high school, nineteen percent have partial but incomplete high school attendance, and six percent have an elementary education.

Materials

The materials used in this study included: a novel, To Kill A Mockingbird (Lee, 1960); a filmstrip and film, To Kill A Mockingbird (1962); books, pamphlets, art work, musical scores and lyrics, essays, and documents of the 1930s; a thematic organizer, and cases dealing with themes in literature novel that

addressed social studies, mathematics, industrial technology, music, and art. For this study, a case was defined as a narrative that presented a theme portrayed in the novel and was presented in a problem-solving format that related text ideas to real-world situations. Cases were developed to help students reason about multiple uses and contexts for information across subjects. A thematic organizer (Alvarez, 1980, 1983; Alvarez & Risko, 1989; Risko & Alvarez, 1986) was used to provoke students to critically deduce other pertinent themes of the book. A thematic organizer is a text adjunct designed to: (1) highlight systematically and explicitly the central theme of the text; (2) relate the theme to experiences and/or knowledge that students already possess; (3) provide cohesion among the ideas to accommodate text structure; and, (4) aid schema construction by elaborating upon new and extended meanings of a thematic concept.

Design

The data derived from the needs assessment, together with preliminary meetings with the principal, vice-principal, librarians, guidance counselor, and faculty representatives determined the conceptual scheme for designing this investigation. Discussions in these meetings indicated that students needed to be versed in both teacher assisted and self-initiated learning strategies. It was agreed that a case base approach to learning with the English teacher and the literature unit serving as the hub would be implemented. This hub would be the base to which other ninth grade faculty members and members

of the community would serve as resource persons for students and the English teacher. Their roles were to consult with students and the English teacher about topics related to their respective subject disciplines and/or experiential knowledge, and to provide materials related to this literature unit.

A mixed paradigm served as the design for this experimental study (see Patton, 1988, 1990). In this paradigm, both qualitative and quantitative data were collected and content analyzed in the same study. The experimental design was interrupted with qualitative data to explain the phenomena being studied. Since student placement into these intact classes was based on achievement scores and class means between the two groups were relatively equal, the design was treated as a true experimental design (see Glass & Stanley, 1970: 505-508). Methods triangulation was an important aspect of this design in that both quantitative and qualitative approaches were compared (Denzin, 1970). Teacher journals, student records of case events, videotapes, a photographic journal, and researcher field notes provided multiple data sources in this monitoring process.

Procedures

The literature novel served as the source of information for case instruction and learning. The 1930s provided the setting for To Kill a Mockingbird. In addition to the traditional instruction for structural elements that accompanies the reading of this novel (e.g., setting, plot, characters, and theme), the

English teacher, in the experimental treatment, was instructed in the use of a thematic organizer (Alvarez, 1983; Alvarez & Risko, 1989; Risko & Alvarez, 1986), and hierarchical concept mapping (Alvarez, et al. 1988; Novak & Gowin, 1984) strategies. A concept map is a visual representation or mental model of an individual's thought processes. Novak (1988) defines a concept map as a "representation of meaning or ideational framework specific to a domain of knowledge, for a given context of meaning."

Students read the first three chapters of the novel (36 pages), and were then presented with a thematic organizer (1 page). The first paragraph identified two children who were main characters and related the setting and events of the 1930s to the present. The second paragraph identified a prominent theme of the novel (i.e., personal consciousness) that was implied in reading the first three chapters. The information that followed asked students to think like the people and about the events portrayed so far in the story. An extracted portion of the text that demonstrated the concept of personal consciouness was presented. Students were asked to think about personal experiences and the feelings they had encounted with this theme. The closing paragraph asked: "At this stage of your reading, what do you view as other important thems of the book?" "Why do you think so?" Give reasons and examples."

Initially, six cases were written by the teacher and researcher from which students' could select a case based on

interest. However, after discussing the themes generated by the students that followed the completion of the thematic organizer, five additional cases were added to the selection: racism, The Depression, fashions of the 1930s, history of Sumner County, and history of the Soviet Union in the 1930s. Students were asked to select one of these cases that were written in a problem solving format and presented targeted concepts of the story. Each case presented a perspective that was different from how the theme was developed in the novel, and each was unique because different reading, research, and writing skills were needed to problem solve and complete the task of the particular case. Each case presented an authentic problem situation that required students to think critically in reaching a plausible and defensible resolution. For example, some cases asked students to keep a journal of their thoughts in working out the case problem, list sources they consulted and materials referenced, make concept maps as their case progressed, and then write a report containing illustrations, maps, mathematical principles and examples to support their position. Other cases required students to present a portion of their findings in a videotape. This required them to write and act out the script for the videotape that they produced and edited. All students were required to write a final report of their findings.

Students engaged in group and class discussions as they studied their respective cases. For example, students who had selected the same case formed groups and discussed their

approaches and resources consulted in gathering information. Class discussions of the novel gave students the opportunity to share what they were investigating as they pertained to the structural elements of the novel. These discussions raised questions that encouraged students to seek additional information in reaching a resolution to their case of inquiry.

The students in the experimental group categorized materials that were provided by other teachers, members of the community, and the librarians to be used as resources. These materials were categorized according to types of cases: journalistic-historical narrative, stories, documents, research data, interpretative essay, vignette, and text (see Newmann & Oliver, 1967). Students added four other categories: oral history (video tapes of invited speakers from the community), visuals and illustrations, propaganda, and recordings.

The comparison group received traditional instruction that accompaines the learning of a novel. Students were asked to identify the pertinent themes, characters, plot, and setting. The teacher followed her regular lesson and assignment plans when teaching this unit. She showed a filmstrip and played a cassette recording that accompanied the novel to her students as an introduction to the reading. Worksheets and model notes were given to the students. Students were asked to keep notes of their reading assignments, and to draw a map depicting the setting of the novel. A film based on the novel was also shown to these students. These students were given two multiple choice

tests, ten regular reading quizes, and essay examinations.During the six week study, students were tested by three common measures: an essay exaination, a timed writing activity, and a final examination.

Students in both the experimental and comparison groups were given the same teacher constructed essay tests and timed writing activity corresponding to the novel and to the objectives and goals of both teachers. Free and timed writings have been advocated for encouraging students to generate spontaneous thoughts (Alvarez, 1983; Elbow, 1973; Holt, 1969; Macrorie, 1970). Timed writings were used in this study to measure the degree of incorporated and compartmentalized knowledge spontaneously generated in an eight minute period. The final essay examination consisted of four short answer questions with subparts that dealt with setting, plot, characterization, and theme. An additional essay question asked the student to relate a theme of the novel to another situation or setting. Students in the experimental group were also asked to construct a concept map and to use their map as a template to write an essay. Responses to this request were used to measure the degree of compartmentalized and incorporated knowledge. The degree of incorporation depended upon the linking of a thematic concept of the novel to existing world knowledge and being able to represent this information in another setting.

Scoring:

Students' performance was evaluated not on correct answers alone, but also according to judged ability to analyze various positions or take a position and justify it rationally. Both teachers scored their own students' essay exams (after studying three chapters), timed writings, (covering middle and near final chapters), and final examinations, and then randomly selected and scored each others. Interrater reliability for these two teachers was .92. Written responses to the final examination were divided into idea units, using Johnson's (1970) method of parsing units, by both teachers. Each student's written answers were then scored for completeness and quality of answers on an ascending rating scale: 0 - if the student gave an incorrect response or did not answer the question; 1 - if the student gave a vague or only a small fragment in answering the question; 2 - if the student gave a partial correct answer to the question; and, 3 - if the student gave a full and complete answer to the question.

Concept maps were analyzed and scored, as a check against the corresponding student essay responses, to assess the degree of compartmentalized or incorporated knowledge by the teacher of the experimental group. The specific criteria for scoring these hierarchical maps were: 0 - the map contained nonrelated information or was not completed; 1 - the map contained information that was vague or fragmentary; 2 - the map contained partial correct information; and, 3 - the map was well developed

hierarchically with propositional relationships that showed a full and complete answer to the question.

RESULTS

Students were required to answer eight short answer questions on the final essay examination and one essay to determine the degree of incorporated knowledge. There were four questions under setting, two of which were literal (i.e., where and when does the story take place?), and two that were inferential (i.e., relationship between setting and characters; how the setting affected the actions of the characters). One-way ANOVAs showed that the experimental group was significantly different from the comparison group on question one that was literal, $F(1,90) = 6.02$, $p < .05$, but did not differ on the second literal question, $F(1,90) = 2.11$. However on the two inferential questions, the experimental group differed significantly from the comparison group, $F(1,90) = 38.82$, $p < .001$ and $F(1,90) = 182.60$, $p < .001$. The experimental group also differed significantly from the comparison group on the literal question that asked students to name and describe the characters, $F(1,90) = 4.69$, $p < .05$., and the inferential question that asked students to explain how one of the characters gave a better understanding of themself or of other people that they knew, $F(1,90) = 21.89$, $p < .01$. There was a significant difference favoring the experimental group on the literal question that asked the plot of the story, $F(1,90) = 7.38$, $p < .01$. The experimental group differed significantly from

the comparison group on the inferential question that dealt with the theme of the story and how the story changed their thinking or behavior, $F(1,90) = 64.12$, $p < .001$. The means and standard deviations for each of these questions are shown on Table 1.

Insert Table 1 about here

Although there were no quantitative differences in answering question two that was literal, there were qualitative differences. Students in the experimental group added additional comments such as comparing the setting of Maycomb, Alabama to their community during that era, citing the distance that they computed from this town to their community. One mentioned that the fictious town was really Monroeville where the author had lived. Two students mentioned the stock market situation during this period, another that "plays and dramas took place in big cities and not in Maycomb." One stated that "Franklin D. Roosevelt was president and supported groups like the people in Maycomb to improve their lives."

Overall, students in the experimental group who received the thematic organizer, and then selected other cases, were able to provide more correct answers to both literal and inferential questions. They were also able to provide more description and incoporate knowledge from other disciplines and settings into their responses.

The final essay question required students to identify one theme of the novel and discuss how this theme could be applied to or explained within another context. The quality of written responses, used to measure the degree of incorporated knowledge, was analyzed using a one-way ANOVA. The results showed a significant difference, $F(1, 90) = 28.77$, $p < .001$ for the treatment. The means and standard deviation of written idea units for each group were: Experimental, 1.37, 1.10; Comparison, 0.36, 0.61, respectively. There were no significant differences between the experimental classses, $F(1,46) = 1.43$, or between the comparison classes, $F(1,42) = 0.001$. The means and standard deviation were: Experimental class 1, 1.60, 1.04, and class 2, 1.21, 1.13; and, Comparison class 1, 0.36, 0.65 and class 2, 0.36, 0.36.

Forty-one students in the experimental group related a theme of the novel to one of eight other settings that corresponded to their case study: mathematical constructions (2), fact or fiction (3), what's the message? (5), time and distance (2), legal system (10), racism (4), The Depression (7), and the arts (8). Six students did not relate the theme of the novel to other settings. Fourteen students in the comparison group related a theme to another setting. These responses were context and subject bound. For example, four students addressed the theme "Don't prejudge anyone," one student wrote "It's wrong to hurt others if you can avoid it," four students wrote that "People aren't always what they seem," four discussed racism (i.e.,

"Prejudice isn't fair (3), "Everyone should be equal (1), and two students made a reference to the Bible (The teacher wrote an annotation about one of these students: "Student doesn't believe in trying to relate to themes of stories. Taught only to relate to Bible." The teacher added in parentheses ("Verified by note from mother."). Twenty-eight of these students did not relate the theme of the novel to another setting.

Concept maps were rated by the teacher in the experimental group to measure the degree of incorporated knowledge. In 48 cases, 7 of the maps were rated lower than the corrresponding essay; 23 were rated equal to the essay, and 18 were rated higher than the corresponding essay.

After reading the first three chapters, thirty students in the experimental group and thirty-six students in the comparison group who were present were given an essay question that asked them to identify themes of the novel. A one-way ANOVA was used to determine if there were any differences in the number of themes generated. No differences were found to exist between the experimental and comparison groups, $F(1, 64) = 0.05$. The means and standard deviations were 1.16, 0.37; and, 1.13, 0.54 respectively. Five themes were identified by students in the experimenal (first number) and comparison group (second number): mockingbird - Don't harm others that don't harm you (6,2), personal consciousness (6,2), racism (16,30), growing up (3,1), and social awareness (3,1). The dominant book theme of racism was evident in both the experimental and comparison group. With

the introduction of cases, the students in the experimental group incorporated other themes, while students in the comparison group continued with this dominant theme throughout the six week study.

A timed writing activity was assessed to determine the degree and spontaneity of incorporated knowledge. Students in the experimental group generated more book related themes and were able to incorporate case related themes into their writings. Students in the comparison group confined their writings to themes generated in the novel. Thirty-four students in the experimental group also incorporated case related themes into their timed writings. These were categorized as: arts (3), legal system (7), mathematical constructions (1), what's the message? (2), fact or fiction (3), The Depression (12), racism (3), and fashion (2).

DISCUSSION

Activating and expanding knowledge through the use of thematically-organized and cross-disciplinary cases facilitated students' ability to generate explanations for new information that were plausible and meaningful. Responses to the timed writing activity and essay questions revealed that students in the experimental group spontaneously incorporated ideas across multiple subject areas rather than confined their answers to a specific subject area (i.e., English) as did students in the comparison group. Analyses of the concept maps made by the experimental group indicated that conceptual representations made

by these students provided an organized scheme for revealing knowledge and creative thought. The ideas represented on the maps corresponded to the respective essay responses and further indicated that students in the experimental group incorporated new information into their existing world knowledge, thereby enhancing schema construction. Not unexpectedly, students in the comparison group kept their responses context and subject-bound. These students had difficulty with inferential questions asking them to make comparisons between the situations described in the novel to other settings.

If we expect critical thinking to take place, we need to provide students with problem solving lessons in meaningful learning contexts. Meaningful in the sense that new information is linked to exisiting concepts, and when learned, becomes incorporated (integrated and related to other knowledge sources in memory) rather than compartmentalized (isolated due to rote memorization). This notion is consistent with Ausubel's (1968) theory of learning, Gowin's (1981/1987) theory of educating, and Gragg's (1954) warning that "wisdom can't be told."

The teacher and her students became active participants in the learning process. Authentic materials and problems allowed students to formulate their own strategies in accomplishing outcomes. Both the teacher and students negotiated meaning in an environment that was mutually adaptable rather than arbitrary and teacher dominated. Genuine questions were raised without preconceived answers. These kinds of questions were asked by

both the teacher and students not to test, but to get information or clarify ambiguities. Different student performances were observed by the cases they selected and in the paths they designed for their resolution (e.g., use of library, research and writing skills, persons consulted, their ability to think and put themselves in the role of an artist, a mathematician, historian, a juror, and so forth). Concepts identfied in the novel were used to construct questions about pertinent ideas with other related contexts. Students were able to relate the ideas of the theme of the novel to their personal life and community (i.e., a photograph of the 1935 GHS football team didn't include any black athletes and lead some students to investigate racial relations of the 1930s in their community).

Information that could have been perceived as artificial became real and meaningful. Students, teachers, relatives, and community members connected with each other in helping to better understand the political and social conditions of the community as it related to the setting and themes of the novel. Self-selected cases allowed students to proceed on their own individual path and reduced their chances to fail. These cases gave students time to construct their own knowledge. During this six weeks, time was not imposed by fractured units (all students on a given page, completing the same exercises), but on personal time schedules driven by curiosity and interest.

Equally important, was that teachers began and ended this study with invested interest and ownership. Teachers evaluated

the instructional techniques and methods in relation to student academic performance. An empirical data base was established; the analyses were related to the needs assessment of the school.

In conclusion, authentic cases spurred curiosity and invited students to initiate critical thinking. They provided students with a forum by which to take an active role in structuring and creating their own meaning.

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Table 1. Means and standard deviations.

		Experimental (n = 48)	Comparison (n = 44)
	Setting		
Question	1	M = 1.00 SD = 0.00	M = 0.00 SD = 0.32
	2	M = 0.83 SD = 0.37	M = 0.93 SD = 0.25
	3	M = 0.93 SD = 0.24	M = 0.43 SD = 0.50
	4	M = 1.0 SD = 0.00	M = 0.20 SD = 0.40
	Character		
	5	M = 1.00 SD = 0.00	M = 0.90 SD = 0.29
	6	M = 0.91 SD = 0.27	M = 0.52 SD = 0.50
	Plot		
	7	M = 0.95 SD = 0.20	M = 0.77 SD = 0.42
	Theme		
	8	M = 0.93 SD = 0.24	M = 0.31 SD = 0.47